Form ESA-B4. Summary Report for ESA-074-2
Public Report - Final

Company	United States Steel Corporation	**ESA Dates**	May 23-25, 2007
Plant	Irvin Plant	**ESA Type**	Process Heating
Product	Steel	**ESA Specialist**	Michael Stocki Northeast Energy Efficiency Solutions

Brief Narrative Summary Report for the Energy Savings Assessment:

Introduction: U. S. Steel's – Irvin Plant, situated in West Mifflin, PA, just outside Pittsburgh is the finishing end of the Mon Valley Works, which consists of four operating plants: Clairton, Edgar Thomson, Irvin and Fairless Plants. The Irvin Plant, which began operations in 1938, takes cold slabs from the Edgar Thomson Plant and converts them into a finished coil. Primary processes include hot rolling using 5 reheat furnaces, cold rolling, pickling, annealing, Temper mill, and finally galvanizing operations. The Irvin Plant produces sheet products for customers in the appliance, automotive, metal buildings and home construction industries.

An Energy Savings Assessment (ESA) was performed at the Irvin Plant to analyze operations of reheat furnaces, batch annealing furnaces, and continuous annealing furnaces. Mr. Nikolas Stevens was the primary support for this assessment. Several people from operations and maintenance participated in assessment activities as well. Additionally, area managers from the hot strip mill, annealing, and galvanizing departments attended the close-out meeting. DOE process-heating specialist Michael Stocki led the assessment. Prior to the assessment, Michael Stocki discussed details of the assessment with Nikolas Stevens, and reviewed available data on energy use in the plant heating equipment. Installation of the Process Heating Assessment and Survey Tool (PHAST) program was completed on all computers used during the assessment.

Objective of ESA: The main objectives of the assessment were to use PHAST to identify energy saving opportunities for selected heating systems in the plant, to provide hands-on training and demonstration of the data collection process, and to analyze the results to estimate potential savings for the identified opportunities.

Focus of Assessment: The assessment focused on process heating systems that use natural gas and coke oven gas as fuel for process heating. The Irvin Plant has several pieces of heating equipment that use a mixture of natural gas and coke oven gas. Some of this equipment includes five reheat furnaces, 58 batch annealing (high pressure hydrogen) furnaces, 24 open coil annealing batch furnaces, a continuous annealing furnace, and two galvanizing furnaces. Energy saving opportunities for all reheat furnaces and a number of batch annealing furnaces, and the continuous annealing furnace were considered during this assessment.

Approach for ESA: The assessment activities included (a) a review of energy use by the plant, (b) a plant tour, (c) a demonstration of PHAST and instructions on its use, (d) collection of the required data for PHAST, and (e) analysis of energy saving opportunities for the systems mentioned above. The performance information was derived from historical data, or actual measurements carried out during the assessment. The plant management was briefed on the assessment results on the third day of the assessment.

General Observations of Potential Opportunities: U. S. Steel is one of the leading corporations in the steel industry, with an active program to achieve energy reduction for its plants worldwide. Plant management is very active in exploring and implementing energy saving practices throughout the plant. They continuously collect and share energy saving practices with other plants. Assessment team members provided help and cooperation in discussing and collecting performance data, and showed great enthusiasm to continue to use the methodology and tools demonstrated during this assessment. They are interested in pursuing short- and medium-term energy saving opportunities.

Natural gas and Coke Oven Gas mixture consumption for the plant in 2006 was approximately 7,000,000 MMBtu.

Major energy saving opportunities identified during this assessment are described briefly below. The main recommendations to improve are: Increasing insulation on the five reheat furnaces, Cleaning the recuperators on each of the reheat furnaces, Improving combustion efficiency / reducing O2 levels on each of the reheat furnaces, Installing waste heat boilers on each of the reheat furnaces, Repairing insulation on a number of the older batch annealing (HPH) furnaces, and finally Repairing insulation on the continuous annealing furnace. Identified energy savings opportunities have potential for savings varying from $80,000 to as high as $3,800,000 per year for the furnaces and equipment assessed during this visit. These savings are based on a "spot-check" of selected furnaces operating at the condition when the assessment was carried out. This estimate of savings should be considered as a sample of possible savings. Plant personnel attending the assessment have shown a willingness to use the PHAST program and methodology to calculate savings for other equipment, over a longer operating period. They are keen on further analyzing and applying the necessary measures that can be economically justified. They also expressed an interest in acquiring the equipment needed to carry out some of the measurements performed during the ESA on their own, if provided with adequate equipment.

Near term opportunities identified during this assessment may save 1% to 2% of the natural gas / coke oven gas cost while the medium term opportunities may save more than 15% of fuel gas cost.

Total natural gas savings for all measures were estimated at 1,033,000 MMBtu, for a total annual savings of $8,070,000. Based on the recommendations, and on discussions with facility personnel and management, our estimate of possible gas savings categorized by ease of implementation is as follows:

a) Near Term opportunities: 111,000 MMBtu Natural Gas / Coke Oven Gas
b) Medium Term opportunities: 901,000 MMBtu Natural Gas / Coke Oven Gas
c) Long Term opportunities: 21,000 MMBtu Natural Gas / Coke Oven Gas

The following provides additional description of each of the potential opportunities:

1. Increase Insulation on Reheat Furnaces – The facility operates 5 reheat furnaces burning a natural gas / coke oven gas mixture. Each furnace operates at approximately 2,350ºF and is used to bring room temperature steel slabs up to temperature for hot rolling. Measurements on the surface of Reheat Furnace #5 indicated an average surface temperature of 310 ºF. There were several hot spots noted and based on conversations with plant personnel, insulation levels could be significantly improved. By improving insulation levels, the energy loss to surroundings and thus the fuel required to maintain these reheat furnaces at temperature will be reduced. It is estimated that this measure will save $760,000 if applied to all furnaces. This assumes a nominal increase in insulation levels, actual savings could potentially be higher.

2. Clean Recuperator on Reheat Furnaces – Each of the 5 reheat furnaces utilizes a recuperator to preheat the incoming combustion air with the hot exhaust gases. Hot gas side temperature drop across the recuperators was in excess of 400ºF while the combustion air was only being preheated to 200ºF - 240ºF. While investigating the reason for the rather poor heat transfer effectiveness across the recuperators, a visual inspection was completed of the cold air side on Reheat Furnace #4 and #5. It was noted that dirt and debris had significantly built up on the heat transfer surfaces thereby reducing the capacity of the recuperators. This was further confirmed by plant personnel that indicated recuperator tube cleaning is never completed due to lack of available down time. It is estimated that cleaning these recuperator tubes will increase the heat transfer and raise the incoming combustion air temperature supplied to the burners. Across all 5 furnaces, this is estimated to n annual cost savings of $880,000.

3. Reduce O_2 on Reheat Furnaces – Each of the 5 reheat furnaces utilizes an air/fuel mixture control supervisory system in conjunction with valves to maintain the correct combustion composition. During the ESA, a combustion analysis was completed on #4 and #5 reheat furnaces. It was measured that the current exhaust was at an average of 7% O_2. It was further determined that the air/fuel mixture controls are limited in their ability to control the ratio at each individual burner because of combustion air piping limitations. It is recommended that the combustion air delivery system be modified such that each individual burner can be properly individually tuned to a more ideal ratio of 3-5%. The measure offers potential energy cost savings of about $2,480,000 per year for all reheat furnaces.

4. Install Waste Heat Boilers on Reheat Furnaces – A number of the existing reheat furnaces utilized waste heat boilers back in the 1950s / 1960s. However, these systems have been decommissioned for many years. The facility has a large and rather constant steam demand (in excess of 60,000 lb/hour of 100 psig steam) used primarily in the pickling and cold mill departments. Finally, current exhaust gas temperatures leaving the reheat furnaces exceeded 1,000ºF indicating potential for additional heat recovery from this energy stream. Therefore, it is recommended that waste heat boilers be installed on all five reheat furnaces. When completed, it is estimated that these boilers could produce 60% - 70% of the facility's current steam demand. The measure offers potential energy cost savings of about $3,780,000 per year for all reheat furnaces.

5. Increase/Repair Insulation on Older Batch Annealing (High Pressure Hydrogen) Furnaces – The facility currently operated 58 high pressure hydrogen (HPH) batch annealing furnaces. During the ESA temperature measurements were taken from the surfaces of 4 of the furnaces running. Upon analysis of the temperature data it was noticed that the older furnaces had an average surface temperature of 200ºF while the newer furnaces with better insulation had an average surface temperature of 150ºF. Therefore, it is recommended that the insulation level in the older furnaces (approximately 29) can be repaired. The measure offers potential energy cost savings of about $90,000 per year.

6. Increase/Repair Insulation on Continuous Annealing Furnace – The facility currently operates a continuous annealing furnace which runs only a portion of the facility's operating hours. Existing surface temperatures were taken during the ESA. Several temperature measurements exceeded 400ºF indicating a critical insulation issue. Repairing and/or installing new insulation will reduce losses to surroundings. The measure offers potential energy cost savings of about $80,000 per year.

Management Support and Comments: The results of the assessment were presented and discussed with plant management, which supports implementing the near-term opportunities with due considerations for the medium and long-term opportunities.

DOE Contact at Plant/Company: DOE may contact Nikolas Stevens, 412-675-2668, NAStevens@uss.com, to monitor progress made toward implementation of the recommendations.

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